

FIELD REPORT – NON-LETHAL PINNIPED DETERRENT ACTIVITIES AT BONNEVILLE DAM, SPRING 2006

January 10, 2007

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INTRODUCTION

In spring of 2006, personnel from the Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW), in cooperation with personnel from the U.S. Army Corps of Engineers (USACE), the National Marine Fisheries Service (NMFS), and the Columbia River Inter-Tribal Fish Commission (CRITFC), conducted a second year of pinniped deterrent activities at and below Bonneville Dam on the Columbia River. See Norberg et al. (2005) for a report on the first year of activities; see Stansell (2004) for a report on pinniped studies at the dam from 2002-2004 as well as observation methodology used from 2002-2006.

Pinniped deterrent activities at Bonneville Dam in 2006 were authorized under the Endangered Species Act (ESA) and Section 109h of the Marine Mammal Protection Act (MMPA). Partial funding for the activities was provided by NMFS, the Pacific States Marine Fisheries Commission (PSMFC), WDFW and ODFW. This report is intended to fulfill ESA, MMPA, NMFS, and PSMFC reporting requirements; as such, it is not a comprehensive report on all pinniped-related interagency activities at the dam during 2006.

2005 sea lion hazing activities

Preliminary testing of boat-based and dam-based hazing first occurred at Bonneville Dam during spring 2005. An interagency working group (ODFW, WDFW, NMFS, USACE and CRITFC) was formed to evaluate the test results and recommend future action (Norberg et al. 2005). The working group recommended the following actions for 2006 at Bonneville Dam, pending available funds.

- Hazing in 2006 should be initiated immediately upon the arrival of sea lions at the dam. Sea lions should be actively discouraged from resting on or near the dam to avoid building a large resident cadre of animals at the facility. Hazing activities should be directed toward animals hauled out or rafting, as well as foraging animals.
- USACE should exclude sea lions from fish passage galleries and ladder weirs.
- Continue to test non-lethal deterrence methods at the facility for broader applicability and to determine level of habituation.

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³ U.S. Army Corps of Engineers (USACE)

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- Continue to evaluate the relative importance of sea lion predation in the river for comparison with other sources of mortality.
- USACE should monitor locks to determine if sea lions are present in the lock chamber before closing the downstream gates. If sea lions are present, active hazing should be conducted to chase the animals out and downstream of the navigation lock. Sea lions should not be locked through upstream.

2006 sea lion hazing activities

Pinniped deterrent activities at Bonneville Dam in 2006 consisted of two complementary and partially concurrent programs (see methods below). Briefly, the first program, conducted by personnel from the USACE and U.S. Department of Agriculture Wildlife Service (USDAWS), employed acoustic and tactile deterrents in the near dam environment in a paired-treatment, randomized block design. The second program, conducted by ODFW/WDFW/CRITFC personnel, was overlaid on the USACE design and consisted of boat-based deterrents from the dam to approximately six miles downstream (to Navigation Marker 85). The goals of both programs were to determine if pinniped abundance and/or salmonid predation was reduced on days when deterrents were employed relative to control days. In addition, the first program included a study to determine if the deterrent efforts had any negative effect on fish passage.

MATERIALS AND METHODS

Personnel

Personnel involved with the 2006 pinniped deterrent activities included staff from ODFW, WDFW, USACE, NMFS, CRITFC, PSMFC, Oregon State Police (OSP), and USDAWS (see acknowledgments).

Safety

Project participants received safety briefings from USACE, ODFW, and WDFW personnel. Briefings covered boat operations and clearance for activities in the Boat Restricted Zone (BRZ) below the dam, overhead hazards, lockout procedures, hazardous water conditions, personal safety equipment (PFDs, ear and eye protection), communications, and project planning details. A safety protocol for pyrotechnic deployment from the boats was also discussed. Boats teams received briefings on vessel safety equipment and rescue procedures at the time of launch. While inside the BRZ, hazing boats maintained VHF-radio contact with the Bonneville Dam Vessel Control officer for status and vessel traffic updates.

Dam-based deterrent activities

Dam-based deterrent activities occurred in the tailrace of Bonneville Dam (Figure 1, top). Full-time daylight observations, coinciding with the onset of deterrent treatments, were conducted by USACE personnel from March 5 to May 27. Partial observations were conducted before and

after treatment activities based on when California sea lions arrived and departed, respectively. The USACE began spilling water from spillway gates at the dam on April 6.

Dam-based deterrent activities were applied in a paired-treatment, randomized block design. Blocks were four days long and consisted of two days each with or without hazing and acoustic deterrent device (ADD) applications (Stansell et al. 2006; Appendix 1). ADDs (205 decibel, 15 kHz frequency) were turned on at 0500 hrs each morning active hazing was conducted and turned off at 2000 hrs on the last hazing day of each two-day ADD treatment (within four-day blocks). Non-lethal pyrotechnics and rubber bullets were used opportunistically by land-based wildlife agents (USDAWS) to haze sea lions within 100 ft of fishway entrances and sea lions hauled out at the dam. Barred gates, or sea lion exclusion devices (SLEDs), were deployed at all main fishway openings during 2006.

Boat-based deterrent activities

Boat-based deterrent activities occurred from the tailrace of the dam downriver to Navigation Marker 85 (Figure 1, bottom), a distance of approximately six miles. The latter area included side channels and tributaries including Tanner Creek and Hamilton Creek. Boat-based deterrent activities occurred from April 2 to May 27. The start date was based on staff availability as well as anticipated salmon run timing.

Personnel conducted boat-based hazing on a systematic four-days on, four-days off schedule such that every four-day period would overlap with the USACE's hazing blocks (Appendix 1). For the first five boat-hazing blocks, access was restricted to 300 m downriver of the dam face; for the remaining two blocks, access was restricted to 100 m downriver of the dam face.

Boat-based hazers used a combination of acoustic and tactile deterrents (seal bombs, cracker shells, rubber buckshot, and vessel chase) in an attempt to deter pinnipeds. One to three boats were employed per day (average = 2) with two to four people per boat (average = 2); hazing was conducted for approximately six hours per day between the hours of 0900-1500 (with half-hour break at noon). Figure 2 illustrates the GPS tracks of two such hazing boat activities on one day in early May.

Scat collection and analysis

California sea lion fecal material (scat) was collected on an opportunistic basis from sea lion haul-out sites near Powerhouse 2 (from cement apron of corner collector on Cascade Island). Undigested remains were recovered and identified to lowest possible taxa by ODFW staff.

RESULTS

Dam-based observations

At least 72 California sea lions, 10 Steller's sea lions, and 3 harbor seals were documented by USACE personnel at Bonneville Dam (Table 1). Of the 72 California sea lions, 25 (35%) were branded, all but two of which had been seen in previous years at the dam (Appendix 2).

An estimated 2.8% (3,023) of the January 1-May 31 salmonid run was taken by sea lions in the tailrace of the dam (Table 2). Other prey consumed by sea lions included Pacific lamprey (*Lampetra tridentata*), which comprised 9.9% of the observed fish caught, and white sturgeon (*Acipenser transmontanus*). Steller sea lions were responsible for all but one of the sturgeon predations whereas nearly all salmonid predation was by California sea lions.

Dam-based and boat-based deterrent activities

Overall, dam-based and boat-based deterrent activities did not appear to reduce the number of salmon taken, or the number of pinnipeds present at the dam, but it did reduce the number of sturgeon taken by Steller sea lions (Figure 3). In general, more salmon were observed taken on days with dam-based hazing and ADD use, though fewer pinnipeds were present near the entrances on those days. Conversely, fewer salmon were observed taken on days of boat-based hazing, but more pinnipeds were present near the entrances.

Boat-based hazers participated in an estimated 1,000 deterrent events or "engagements" (where an engagement was defined as actively hazing one or more individual sea lions). Approximately 6,000 seal bombs, 8,000 cracker shell rounds, 1,500 rubber bullet rounds, and 1,000 screamers/poppers were used by boat-based hazers to deter sea lions over the course of the season. Based on a tally of over 400 recorded engagements, approximately 50% of the hazed animals responded by moving downriver away from the dam, 10% moved upriver towards the dam, and response of the remaining 40% could not be determined (Table 3).

No pinnipeds or fish were observed injured during the course of dam-based or boat-based hazing activities; however injured fish might sink and not be seen.

Scat collection and analysis

Twenty California sea lion scat samples were collected and analyzed (Table 4). The predominant prey item was adult salmonid (found in 95-100% of the scat) followed by lamprey (40%) and juvenile salmonid (25%).

CONCLUSIONS

Efficacy of pinniped deterrents

Results indicate that neither dam-based nor boat-based deterrents produced an appreciable effect on California sea lion abundance or salmonid predation in the near dam environment (Figure 3). However, sturgeon predation by Steller sea lions stopped completely following the start of boat-based hazing and there was also a short-term decrease in salmonid predation. These declines

also coincided with the start of the spill on April 6 and therefore the effects of hazing are confounded somewhat with spill conditions.

Effects of deterrents on fish passage

Jepson et al. (2006) used radiotelemetry to evaluate the behavior of adult spring Chinook salmon in response to SLEDs, sea lion hazing, and ADD treatments. Their analyses suggested that the combined effects of hazing and ADDs did not impede the passage of radio-tagged adult spring Chinook salmon. Similarly, SLEDs alone did not appear to impede salmon passage based on inter-year comparisons.

RECOMMENDATIONS

- Dam-based and boat-based hazing should be initiated upon the arrival of sea lions at the dam.
- Boat hazing should be allowed in close proximity to the dam and coordinated with dam-based hazing activities to eliminate gaps in spatial and temporal hazing coverage.
- A floating sea lion trap should be established as a haulout area in the BRZ to determine the feasibility of capturing animals for management and research purposes. Capture and marking efforts should occur throughout the season as possible.
- Sea lions should be actively discouraged from resting on or near the dam structure in order to encourage use of the floating trap.
- USACE should continue efforts to exclude sea lions from fish passage galleries, ladder weirs, and other fish entryways.
- Distribution, abundance and predation throughout the river should be determined (e.g., through aerial and boat surveys and bioenergetic modeling).
- Scat should be collected throughout the river to estimate diet composition. Genetic analysis of salmonid bones recovered from scat should be conducted to identify bones to species, ESU/DPS, and/or run.

ACKNOWLEDGEMENTS

We wish to acknowledge and thank all those who cooperated in the conduct of this work:

- ODFW: Steve Williams, Charlie Corrarino, Susan Riemer, Matthew Hunter, Zach Forster, Tom Neill, Devin Volenec
- WDFW: Guy Norman, Captain Murray Schlenker, Pat Miller, Jeff Gould, Bill Fleenor, Officer Gary Orr, Officer Tim Meyers, Officer Dave Hughes, Officer Tom Moats, Officer Mark Hart
- USACE (Bonneville Dam): Bob Willis, David Clugson, Ben Hausman
- NMFS: Pat Gearin
- CRITFC: John Whiteaker
- PSMFC: Matt Tennis and Dan Heiner

- OSP: Captain Steve Lane, Senior Trooper Roger Edwards and Senior Trooper Ken Moore
- USDA Wildlife Services

Partial funding was provided by NOAA-Fisheries to WDFW (Contract AB133FO55E67980), by the PSMFC to WDFW (Contract 497E.07), and by NOAA-Fisheries to PSMFC (Contract NA05NMF4391151). Special thanks to Garth Griffin from NOAA-Fisheries and Dave Colpo from PSMFC for help with contract administration and coordination.

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Table 1. Summary of pinniped abundance and duration at the Bonneville Dam tailrace spring 2006 (source: USACE).

| | 2006 |
|---|--------|
| Total number of individual pinnipeds | 85 |
| California sea lions | 72 |
| Steller sea lion | 10 |
| Harbor seals | 3 |
| Maximum daily number of pinnipeds | 46 |
| Maximum number of days individual was present | 72 |
| Date of first pinniped sighting | 2/9/06 |
| Date of last pinniped sighting | 6/5/06 |
| Total number of days pinnipeds present | 117 |

Table 2. Summary of salmonid abundance¹ and estimated take by sea lions at Bonneville Dam during spring 2006 (source: USACE).

| | 2006 |
|--|---------|
| Salmonid abundance ¹ | 105,063 |
| Estimated predation loss | 3,023 |
| Minimum percentage of run consumed by sea lions ² | 2.80% |

¹ Combined Chinook and steelhead abundance passing Bonneville Dam during USACE study period.

² =Estimated take/(estimated take + salmonid abundance).

Table 3. Summary of outcomes from approximately 400 recorded “engagements” between boat-based hazers and sea lions (source: ODFW/WDFW).

| Engagement outcome | Percent of engagements |
|--------------------|------------------------|
| Moved downriver | 52% |
| Unknown | 40% |
| Moved upriver | 8% |

Table 4. Percent frequency of occurrence (FO) of prey items identified in scat (n=20) collected from a haul-out used by California sea lions near Powerhouse-2, May 4-6, 2006 (source: ODFW).

| Prey item | Frequency of occurrence (%) |
|---|-----------------------------|
| Adult salmonids | 95 ^{1, 2} |
| Lamprey species | 40 |
| Juvenile salmonids | 25 |
| Unidentified (probably salmonid and pikeminnow) | 10 |
| Clupeidae species (probably American shad) | 5 |
| Gadidae species (probably Pacific tomcod) | 5 |

¹ The single scat without identifiable salmonid remains contained ribs that were most likely from a salmonid. If so then salmonid FO would be 100%.

² A PIT tag was found in a scat collected on May 4. The PIT tag (3D9.1BF112523A) was from an adult Chinook of unknown run or rear type. The Chinook was PIT and radio tagged on 4/18/06 in the Bonneville fish ladder and re-released downstream by Jepson et al. (2006) as part of their research on the effects of non-lethal sea lion deterrent activities on salmonids.

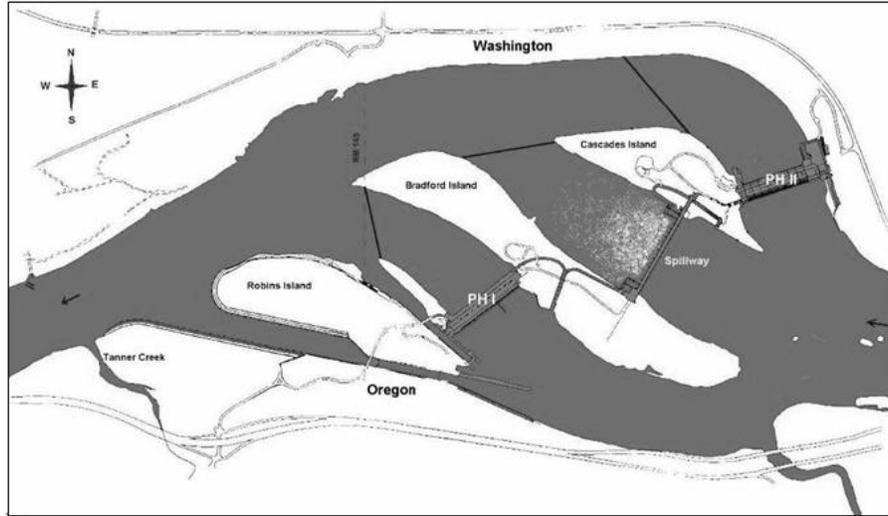


Figure 1. Overview of Bonneville Dam study area showing areas covered by dam-based deterrent activities and observations (diagram, top; from Stansell 2004) and boat-based deterrent activities (2005 orthoimagery, bottom). Dark lines on top diagram indicate downriver extent of predation observation areas.



Figure 2. On-board GPS tracks of two hazing boats in early May, 2006, showing areas patrolled to haze sea lions.

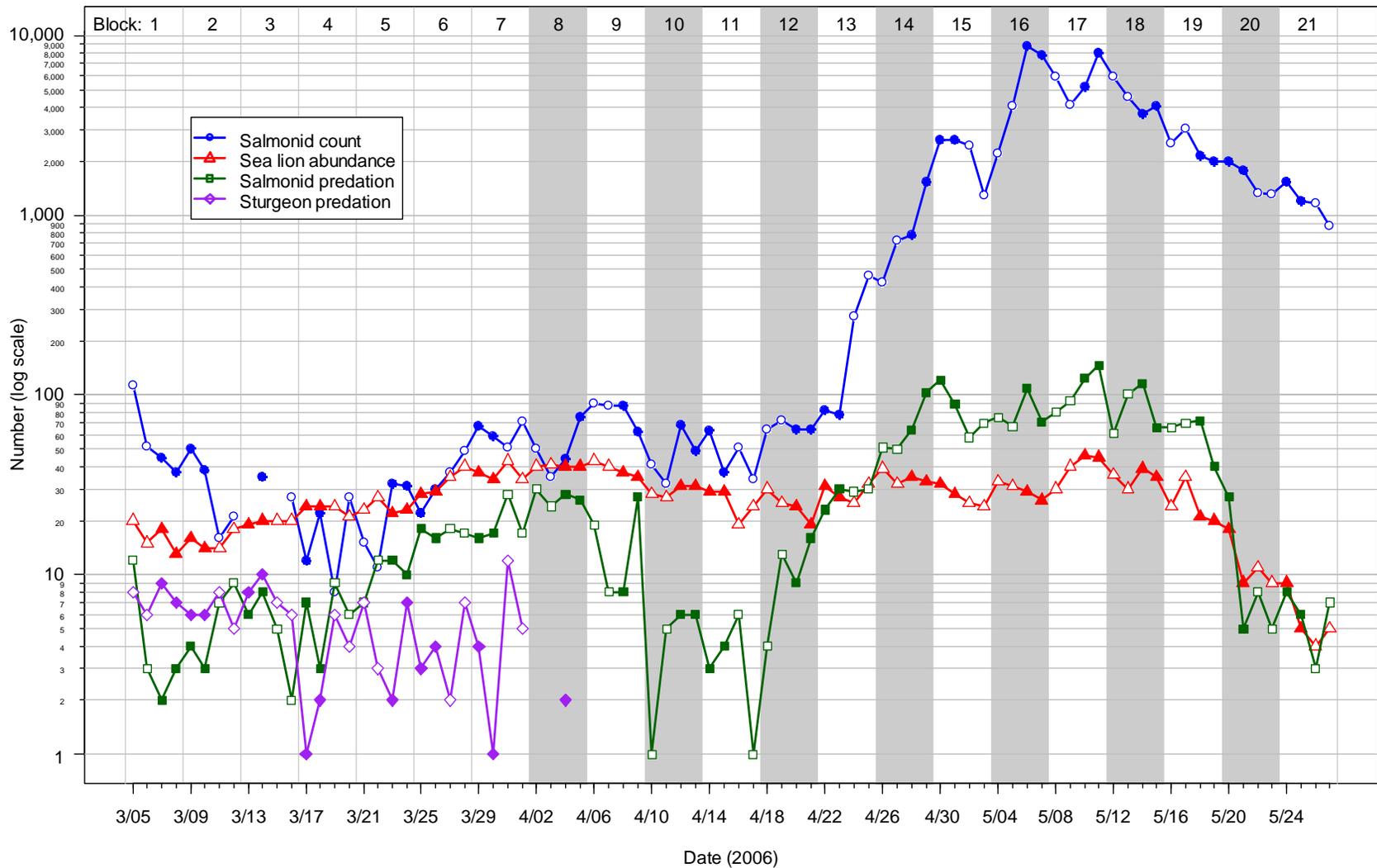


Figure 3. Preliminary results of 2006 non-lethal deterrence experiments at Bonneville Dam (source: USACE). Solid symbols (circles, triangles, squares, diamonds) indicate days within blocks on which dam-based deterrent treatments occurred; vertical gray bars indicate blocks on which boat-based deterrent treatments occurred (see Appendix 1). All sturgeon predation (except one) was by Steller sea lions; nearly all salmonid predation was by California sea lions. Note: spill began on April 6.

Appendix 1. Bonneville Dam pinniped deterrence schedule (X=treatment days).

| Block | Date | Dam hazing | Boat hazing | Notes |
|-------|-----------|------------|-------------|-----------------------------|
| 1 | 3/5/2006 | | | |
| | 3/6/2006 | | | |
| | 3/7/2006 | X | | |
| | 3/8/2006 | X | | |
| 2 | 3/9/2006 | X | | |
| | 3/10/2006 | X | | |
| | 3/11/2006 | | | |
| | 3/12/2006 | | | |
| 3 | 3/13/2006 | X | | |
| | 3/14/2006 | X | | |
| | 3/15/2006 | | | |
| | 3/16/2006 | | | |
| 4 | 3/17/2006 | X | | |
| | 3/18/2006 | X | | |
| | 3/19/2006 | | | |
| | 3/20/2006 | | | |
| 5 | 3/21/2006 | | | |
| | 3/22/2006 | | | |
| | 3/23/2006 | X | | |
| | 3/24/2006 | X | | |
| 6 | 3/25/2006 | X | | |
| | 3/26/2006 | X | | |
| | 3/27/2006 | | | |
| | 3/28/2006 | | | |
| 7 | 3/29/2006 | X | | |
| | 3/30/2006 | X | | |
| | 3/31/2006 | | | |
| | 4/1/2006 | | | |
| 8 | 4/2/2006 | | X | Boats to >300 m of dam face |
| | 4/3/2006 | | X | |
| | 4/4/2006 | X | X | |
| | 4/5/2006 | X | X | |
| 9 | 4/6/2006 | | | Spill begins |
| | 4/7/2006 | | | |
| | 4/8/2006 | X | | |
| | 4/9/2006 | X | | |
| 10 | 4/10/2006 | | X | |
| | 4/11/2006 | | X | |
| | 4/12/2006 | X | X | |
| | 4/13/2006 | X | X | |
| 11 | 4/14/2006 | X | | |
| | 4/15/2006 | X | | |

| Block | Date | Dam hazing | Boat hazing | Notes |
|-----------|-----------|------------|-------------|--|
| | 4/16/2006 | | | |
| | 4/17/2006 | | | |
| 12 | 4/18/2006 | | X | |
| | 4/19/2006 | | X | |
| | 4/20/2006 | X | X | |
| | 4/21/2006 | X | X | |
| 13 | 4/22/2006 | X | | |
| | 4/23/2006 | X | | |
| | 4/24/2006 | | | |
| 14 | 4/25/2006 | | | |
| | 4/26/2006 | | X | |
| | 4/27/2006 | | X | |
| | 4/28/2006 | X | X | |
| 15 | 4/29/2006 | X | X | |
| | 4/30/2006 | X | | |
| | 5/1/2006 | X | | |
| 16 | 5/2/2006 | | | |
| | 5/3/2006 | | | |
| | 5/4/2006 | | X | |
| | 5/5/2006 | | X | |
| 17 | 5/6/2006 | X | X | |
| | 5/7/2006 | X | X | |
| | 5/8/2006 | | | |
| 18 | 5/9/2006 | | | |
| | 5/10/2006 | X | | |
| | 5/11/2006 | X | | |
| | 5/12/2006 | | X | Boats to >100 m of dam face |
| 5/13/2006 | | X | | |
| 5/14/2006 | X | X | | |
| 5/15/2006 | X | X | | |
| 19 | 5/16/2006 | | | |
| | 5/17/2006 | | | |
| | 5/18/2006 | X | | |
| 20 | 5/19/2006 | X | | |
| | 5/20/2006 | X | X | Sea lions depart on breeding migration |
| | 5/21/2006 | X | X | |
| | 5/22/2006 | | X | |
| 5/23/2006 | | X | | |
| 21 | 5/24/2006 | X | | |
| | 5/25/2006 | X | | |
| | 5/26/2006 | | | |
| | 5/27/2006 | | | |

Appendix 2. Duration and trip frequency of 25 individually marked sea lions observed feeding on salmonids below Bonneville Dam during spring 2006.

| Animal ID | Date marked | No. of days seen at dam (no. of trips from Astoria) | | | | |
|-----------|-------------|---|--------|--------|--------|--------|
| | | 2002 | 2003 | 2004 | 2005 | 2006 |
| C147 | 4/1/2000 | | 7 (2) | 17 (4) | 15 (3) | 3 (1) |
| C192 | 3/12/2001 | | 8 (1) | 6 (2) | 17 (2) | 15 (1) |
| C247 | 2/22/2002 | | 10 (2) | 23 (5) | 18 (1) | 19 (2) |
| C257 | 3/15/2002 | 4 (1) | 4 (1) | 2 (1) | | 1 (1) |
| C265 | 4/5/2002 | 3 (2) | 17 (3) | 18 (3) | 40 (2) | 15 (3) |
| C287 | 5/8/2002 | | | | 6 (2) | 17 (1) |
| C309 | 8/29/2002 | | 19 (4) | 22 (4) | 18 (3) | 44 (1) |
| C319 | 9/18/2002 | | 16 (4) | 14 (3) | 17 (2) | 43 (2) |
| C322 | 9/23/2002 | | 10 (2) | 28 (3) | 17 (3) | 44 (2) |
| C335 | 10/3/2002 | | | 1 (1) | | 3 (1) |
| C360 | 12/10/2002 | | | | | 8 (1) |
| C379 | 1/31/2003 | | | | 13 (2) | 31 (1) |
| C390 | 2/10/2003 | | | | 9 (2) | 37 (1) |
| C404 | 3/11/2003 | | 20 (3) | 13 (2) | 31 (1) | 59 (1) |
| C417 | 3/27/2003 | | | 9 (1) | 12 (2) | 14 (1) |
| C440 | 4/16/2003 | | | 11 (1) | 15 (2) | 44 (2) |
| C441 | 4/18/2003 | | 3 (1) | | 1 (1) | 2 (1) |
| C443 | 4/18/2003 | | | 31 (4) | 13 (2) | 37 (1) |
| C444 | 4/25/2003 | | 3 (1) | 19 (2) | 8 (3) | 17 (1) |
| C449 | 4/25/2003 | | 1 (1) | 8 (1) | | 1 (1) |
| C455 | 5/1/2003 | | | | 18 (2) | 7 (2) |
| C507 | 3/31/2004 | | | 11 (3) | 17 (3) | 44 (1) |
| C554 | 9/6/2005 | | | | | 24 (1) |
| B818 | | | 2 (1) | 1 (1) | | 1 (1) |
| SMI 3341 | | | | 3 (2) | 4 (1) | 18 (1) |